



HIGH SCHOOL ALGEBRA: AUSSIE FIR TREE RUBRIC


The rubric section contains a scoring guide and performance level descriptions for the Aussie Fir Tree task.

Scoring Guide: The scoring guide is designed specifically to each small performance task. The points highlight each specific piece of student thinking and explanation required of the task and help teachers see common misconceptions (which errors or incorrect explanations) keep happening across several papers. The scoring guide can then be used to refer back to the performance level descriptions.

Performance Level Descriptions: Performance level descriptions help teachers think about the overall qualities of work for each task by providing information about the expected level of performance for students. Performance level descriptions provide score ranges for each level, which are assessed using the scoring guide.

**High School Algebra: Aussie Fir Tree
Rubric**

Aussie Fir Tree Scoring Guide

The Aussie Fir Tree		Rubric	
<p>The elements of performance required by this task are:</p> <ul style="list-style-type: none"> • Recognizes geometric patterns. • Visualizes, extends and describes patterns. • Determines a solution to a polynomial relationship. • Develops an algebraic equation that models the growth of a quadratic function. • Verifies the inverse relationship of the polynomial equation. 		Points	Section Points
<p>1. Draws stage 5 with 30 unit squares.</p> <p>Describes stage 5 such as: The trunk is ten unit squares tall and there are four sets of branches 3, 5, 7 and 9 units.</p> 		1 1	2
<p>2. Describe the growing pattern such as:</p> <p>It grows by consecutive even numbers from stage to stage. The pattern grows between each stage by 2, 4, 6, 8,...</p>		2	2
<p>3. 110 unit squares.</p> <p>Show work such as: Stage 5 is 30 or $5 \cdot 6$, Stage 6 is 42 or $6 \cdot 7$, Stage 7 is 56, or $7 \cdot 8$ so, Stage 10 is $10 \cdot 11 = 110$ unit squares.</p>		1 1	2
<p>4. Unit squares = $n(n+1)$</p> <p><i>Partial Credit</i> Provide a correct expression</p>		2 (1)	2
<p>5. Provides an explanation such as: No two consecutive integers when multiplied together equals 274. The consecutive integers $16 \cdot 17 = 272$. The next smallest product would be $17 \cdot 18 = 306$, which is too large.</p>		2	2
Total Points			10

High School Algebra: Aussie Fir Tree Rubric

Performance Level Descriptions and Cut Scores

Performance is reported at four levels: 1 through 4, with 4 as the highest.

Level 1: Demonstrates Minimal Success (0-3 points)

The student's response shows few of the elements of performance that the tasks demand. The work shows a minimal attempt on the problem and struggles to make a coherent attack on the problem. Communication is limited and shows minimal reasoning. The student's response rarely uses definitions in their explanations. The student struggles to recognize patterns or the structure of the problem situation.

Level 2: Performance below Standard (4-5 points)

The student's response shows some of the elements of performance that the tasks demand and some signs of a coherent attack on the core of some of the problems. However, the shortcomings are substantial and the evidence suggests that the student would not be able to produce high-quality solutions without significant further instruction. The student might ignore or fail to address some of the constraints. The student may occasionally make sense of quantities in relationships in the problem, but their use of quantity is limited or not fully developed. The student response may not state assumptions, definitions, and previously established results. While the student makes an attack on the problem, it is incomplete. The student may recognize some patterns or structures, but has trouble generalizing or using them to solve the problem.

Level 3: Performance at Standard (6-7 points)

For most of the task, the student's response shows the main elements of performance that the tasks demand and is organized as a coherent attack on the core of the problem. There are errors or omissions, some of which may be important, but of a kind that the student could well fix, with more time for checking and revision and some limited help. The student explains the problem and identifies constraints. The student makes sense of quantities and their relationships in the problem situations. The student often uses abstractions to represent a problem symbolically or with other mathematical representations. The student response may use assumptions, definitions, and previously established results in constructing arguments. They may make conjectures and build a logical progression of statements to explore the truth of their conjectures. The student might discern patterns or structures and make connections between representations.

Level 4: Achieves Standards at a High Level (8-10 points)

The student's response meets the demands of nearly the entire task, with few errors. With some more time for checking and revision, excellent solutions would seem likely. The student response shows understanding and use of stated assumptions, definitions and previously established results in construction arguments. The student is able to make conjectures and build a logical progression of statements to explore the truth of their conjecture. The student response routinely interprets their mathematical results in the context of the situation and reflects on whether the results make sense. The communication is precise, using definitions clearly. Students look closely to discern a pattern or structure. The body of work looks at the overall situation of the problem and process, while attending to the details.

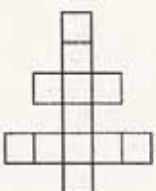


HIGH SCHOOL ALGEBRA: AUSSIE FIR TREE

High School Algebra: Aussie Fir Tree

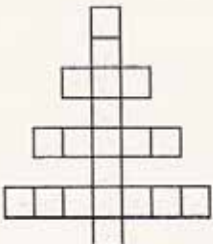
Student A

Stage 3

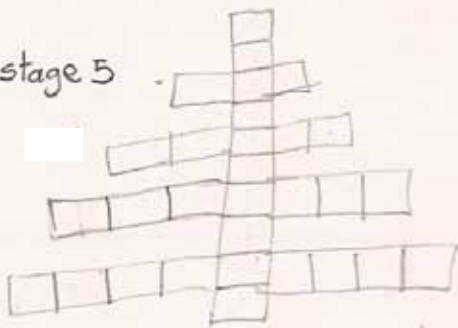


12 unit squares

Stage 4



stage 5



1. Draw and describe **Stage 5** of the pattern in terms of its shape and number of unit squares needed to construct the fir tree.

High School Algebra: Aussie Fir Tree

2. Describe how the pattern is growing?

from the stage 1 to stage 2 "4" is added,
from stage 2 to stage 3 "6" is added, from
stage 3 to stage 4 "8" is added.

3. How many unit squares are needed to build a Stage 10 Aussie Fir Tree?
Show your work.

Stage	unit squares
5	30
6	42
7	56
8	72
9	90
10	110

we need 110 unit
squares to build
stage 10. because
from stage 1 to 2 you added a 4
from stage 2 to 3 you added a 6
and so on.
you keep adding a 2 to
the number you
added.

4. Given any stage number n , determine a closed form equation to determine
the amount of unit squares needed to build the tree.

$$y = (n+1) \cdot n$$

5. Your mate tells you that exactly 274 unit squares will make an Aussie Fir Tree. He is wrong. Explain to him why his statement is false.

Performance Task

The Aussie Fir Tree

P 2


(c) joint copyright Silicon Valley Mathematics Initiative, SCALE, New York City DOE, 2010.

His statement is false because none of the stage
number can have 274 unit. The stage number 16 has
272 unit but that less than 274 unit. And stage number 17 has
282 unit and that's more than 274 unit.

High School Algebra: Aussie Fir Tree

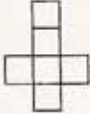
Student B

Stage 1 $\times 2$



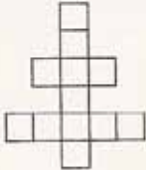
2 unit squares

Stage 2 $\times 3$



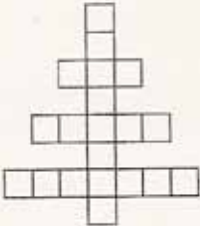
6 unit squares

Stage 3 $\times 4$



12 unit squares

Stage 4 $\times 5$



20 units

1. Draw and describe Stage 5 of the pattern in terms of its shape and number of unit squares needed to construct the fir tree.

Stage 5 has one more branch with an extra square on each side.

Stage 5 = $5 \times 6 = 30$ units

High School Algebra: Aussie Fir Tree

Stage 5
5x6



30 units

2. Describe how the pattern is growing?

Each branch has one more unit on each side and one extra on the bottom.

The stage # multiplied by stage # + 1 gives the amount of unit squares needed.

3. How many unit squares are needed to build a Stage 10 Aussie Fir Tree?
Show your work.

$$n(n+1)$$

$$\text{Stage } 10 \rightarrow 10 \times 11 = 110 \text{ units}$$

4. Given any stage number n , determine a closed form equation to determine the amount of unit squares needed to build the tree.

$$n(n+1) = a$$

a = amount of unit squares needed.

5. Your mate tells you that exactly 274 unit squares will make an Aussie Fir Tree. He is wrong. Explain to him why his statement is false.

Because no 2 consecutive #'s multiply to equal 274.

Performance Task

The Aussie Fir Tree

P2


(c) joint copyright Silicon Valley Mathematics Initiative, SCALE, New York City DOE, 2010.

High School Algebra: Aussie Fir Tree

Student C


growing in ice.

Stage 1




2 units squares

Stage 2




6 units squares

Stage 3



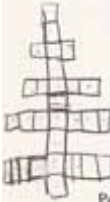
12 units squares

Stage 4



20 units squares

1. Draw and describe Stage 5 of the pattern in terms of its shape and number of unit squares needed to construct the fir tree.



30 units squares

Performance Task The Aussie Fir Tree P 1

(c) Silicon Valley Mathematics Initiative 2010. To reproduce this document, permission must be granted by the

High School Algebra: Aussie Fir Tree

The Aussie Fir Tree

It grows down under

2. Describe how the pattern is growing?

$$2 \xrightarrow{+4} 6 \xrightarrow{+6} 12 \xrightarrow{+8} 20$$

The Pattern is quadratic, and it is increasing by 2 in the second difference.

3. How many unit squares are needed to build a Stage 10 Aussie Fir Tree? Show your work.

$$2 \xrightarrow{+4} 6 \xrightarrow{+6} 12 \xrightarrow{+8} 20 \xrightarrow{+10} 30 \xrightarrow{+12} 42 \xrightarrow{+14} 56 \xrightarrow{+16} 72 \xrightarrow{+18} 90 \xrightarrow{+20} 110$$

Stage 10 = 110

4. Given any stage number n , determine a closed form equation to determine the amount of unit squares needed to build the tree.

Stage # = 3, $n+3 = X$

I put stage 3 for an example and added n by n so the answer will be X until I find what n equals.


5. Your mate tells you that exactly 274 unit squares will make an Aussie Fir Tree. He is wrong. Explain to him why his statement is false.

$$110 \xrightarrow{+22} 132 \xrightarrow{+24} 156 \xrightarrow{+26} 182 \xrightarrow{+28} 210 \xrightarrow{+30} 240 \xrightarrow{+32} 272$$

You can't make one because it would be 2 units short.


High School Algebra: Aussie Fir Tree

Student D



1. Draw and describe **Stage 5** of the pattern in terms of its shape and number of unit squares needed to construct the fir tree.

Each stage adds 2 more units to the tree bottom and the sides.



Performance Task The Aussie Fir Tree P 1

(c) joint copyright Silicon Valley Mathematics Initiative, SCALE, New York City DOE, 2010.

High School Algebra: Aussie Fir Tree

2. Describe how the pattern is growing?

The tree grows with 2 units added to the bottom at every stage.
However many units were previously at the side there's also
2 more units added to that number to put at the next stage.

3. How many unit squares are needed to build a **Stage 10** Aussie Fir Tree?

Show your work.

Stage 9 - 78 units
To build a Stage 10 Aussie Fir Tree
You need 98 unit squares.

$$\begin{array}{r} 78 \\ + 20 \\ \hline 98 \end{array}$$

Stage 10 - 98

4. Given any stage number n , determine a closed form equation to determine the amount of unit squares needed to build the tree.

5. Your mate tells you that exactly 274 unit squares will make an Aussie Fir Tree. He is wrong. Explain to him why his statement is false.

Performance Task

The Aussie Fir Tree

P 2

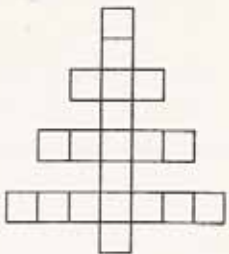
(c) joint copyright Silicon Valley Mathematics Initiative, SCALE, New York City DOE, 2010.

He is wrong because he needs to know what stage and
the number of units from the previous stage to know
how much unit squares makes up one tree/stage.

High School Algebra: Aussie Fir Tree

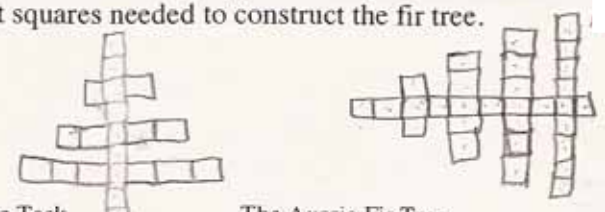
Student E

Stage 4



20

1. Draw and describe **Stage 5** of the pattern in terms of its shape and number of unit squares needed to construct the fir tree.



30 squares

Performance Task The Aussie Fir Tree P 1

(c) Silicon Valley Mathematics Initiative 2010. To reproduce this document, permission must be granted by the
SUMI info@sumiinc.org

High School Algebra: Aussie Fir Tree

2. Describe how the pattern is growing?

It is adding two more squares down but on the top of the two it is adding the amount of square equal to the stage number minus one on each side.

3. How many unit squares are needed to build a Stage 10 Aussie Fir Tree?

Show your work. It would need 110 squares.

X	y
1	2
2	6
3	12
4	20
5	30

x	y
5	30
6	42
7	56
8	72
9	90
10	110

4. Given any stage number n , determine a closed form equation to determine the amount of unit squares needed to build the tree.

$x = \text{stage number}$

$y = \text{total \# of squares}$

$$x^2 + (x-1) = y$$

5. Your mate tells you that exactly 274 unit squares will make an Aussie Fir Tree. He is wrong. Explain to him why his statement is false.

His statement is wrong because if you use the equation above then it wouldn't be able to do the equation backwards the closest to 274 units would be 280. That would mean that it wouldn't make a Aussie Fir tree. This is proven in the table on the left.

x	y
10	110
11	132
12	156
13	182
14	210
15	240
16	272

Performance Task

The Aussie Fir Tree

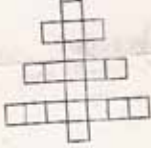
P 2

(c) Silicon Valley Mathematics Initiative 2010. To reproduce this document, permission must be granted by the SVMi info@svmimac.org

High School Algebra: Aussie Fir Tree


Student F

Stage 4



20 unit squares

1. Draw and describe Stage 5 of the pattern in terms of its shape and number of unit squares needed to construct the fir tree.



30 unit squares

The pattern in the ~~stage~~ figures are is that the squares going horizontally are going up by odd numbers and the vertical ~~squares~~ squares are going up by even numbers.

The Aussie Fir Tree
Performance Task
(c) joint copyright Silicon Valley Mathematics Initiative, SCALE, New York City DOE, 2010.

2. Describe how the pattern is growing?

The pattern is growing by odd and even numbers.

3. How many unit squares are needed to build a Stage 10 Aussie Fir Tree? Show your work.

30-unit squares - stage 5

60 unit squares $\times \frac{2}{10}$

4. Given any stage number n , determine a closed form equation to determine the amount of unit squares needed to build the tree.

5. Your mate tells you that exactly 274 unit squares will make an Aussie Fir Tree. He is wrong. Explain to him why his statement is false.

Performance Task
(c) joint copyright Silicon Valley Mathematics Initiative, SCALE, New York City DOE, 2010.

The Aussie Fir Tree
P 2